

PATENT COOPERATION TREATY
PCT
INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P/70017.WOP/LML	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/01112	International filing date (<i>day/month/year</i>) 31/03/2000	Priority date (<i>day/month/year</i>) 01/04/1999

International Patent Classification (IPC) or national classification and IPC
H02K3/40

Applicant

ALSTOM UK LTD.

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 9 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I Basis of the report
- II Priority
- III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV Lack of unity of invention
- V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI Certain documents cited
- VII Certain defects in the International application
- VIII Certain observations on the international application

Date of submission of the demand 01/11/2000	Date of completion of this report 27.04.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer van der Haegen, D Telephone No. +49 89 2399 2683



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/01112

I. Basis of the report

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):
Description, pages:

1-16 as originally filed

Claims, No.:

1-26 as originally filed

Drawings, sheets:

1/4-4/4 as originally filed

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

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the drawings, sheets:

5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):
(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

the entire international application.

claims Nos. 23-26.

because:

the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 23-26 are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet

the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

the written form has not been furnished or does not comply with the standard.

the computer readable form has not been furnished or does not comply with the standard.

IV. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N) Yes: Claims 1-7, 9-12, 14-18, 21-22

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	No:	Claims 8, 13, 19-20
Inventive step (IS)	Yes:	Claims 14-18, 22
	No:	Claims 1-13, 19-21
Industrial applicability (IA)	Yes:	Claims 1-22
	No:	Claims

**2. Citations and explanations
see separate sheet**

VII. Certain defects in the International application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the International application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

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Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. Claims 23-26 solely rely on references to the drawings (see Section VIII.1 of this report). It is therefore difficult, if not impossible, to determine the matter for which protection is sought by said claims. Hence, no opinion is established for claims 23-26.

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents :

- D1: EP-A-0 266 602 (ASEA AB) 11 May 1988,
- D2: EP-A-0 951 132 (ABB RESEARCH LTD) 20 October 1999,
- D3: US-A-5 710 475 (BAUMGARTNER CHARLES EDWARD ET AL) 20 January 1998,
- D4: EP-A-0 760 282 (KANEKA FUCHI CHEMICAL IND) 5 March 1997,
- D5: DE 195 47 229 A (ASEA BROWN BOVERI) 19 June 1997,
- D6: US-A-4 008 409 (RHUDY RALPH G ET AL) 15 February 1977 and,
- D7: GB-A-1 526 081 (WESTINGHOUSE ELECTRIC CORP.) 27 September 1978.

Document D7 was not cited in the international search report.

- 2.1 The present application does not meet the requirements of Article 33(3) PCT, because the subject-matter of claim 1 does not involve an inventive step, the reason being as follows :
- 2.2 Document D1, which is considered to represent the most relevant state of the art, discloses (cf. Figure 2) :
 - a composite conductor **suitable for use as a winding of a high voltage**

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EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01112

electrical machine (cf. column 2, lines 52-54),

- a plurality of strands (18) of conductor material forming a conductor bundle (17) which in cross-section is of generally rectangular shape,
- the strands (18) being insulated (19) from each other within the bundle (17),
- an insulation sleeve (14) of substantially homogeneous polymeric material (cf. column 3, lines 30-34),
- the insulation sleeve (14) having a generally rectangular shape in cross-section and,
- the polymeric material being filled with at least one electrically insulating filler material which conducts heat more efficiently than the polymer alone (cf. column 2, lines 1-6).

2.3 The subject-matter of claim 1 differs from this disclosure in that conductive material forming a corona shield coating at the inner and outer surfaces of the insulation sleeve is provided.

The problem to be solved by the present invention may therefore be regarded as to prevent electrical degradation of the insulation sleeve due to corona discharges across voids between the conductor material and the insulation sleeve and across voids between the insulation sleeve and the stator slot walls.

However, a solution to this problem has already been proposed in a similar composite conductor, see document D6, column 4, lines 23-28. It would be obvious to the person skilled in the art, namely when the same result is to be achieved, to apply these features with corresponding effect to a composite conductor according to document D1, thereby arriving at a composite conductor according to claim 1. The subject-matter of claim 1 does therefore not involve an inventive step (Article 33(3) PCT).

3. Rounding the corners of rectangular shaped conductor bundles and insulation sleeves is a measure well-known to those skilled in the art in order to prevent corona discharge at these corners (cf. document D7, page 1, lines 10-22). The solutions provided by subject-matter of claims 2-6 therefore come within the scope of the customary practice followed by persons skilled in the art. Consequently, the subject-matter of claims 2-6 lacks an inventive step.

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EXAMINATION REPORT - SEPARATE SHEET**

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4. Twisting a conductor bundle around the longitudinal centerline of the bundle in order to reduce losses from eddy currents is a normal design procedure. The subject-matter of claim 7 does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT.
5. The features introduced by the subject-matter of claim 8 are known from document D1 (cf. column 2, lines 1-6).
6. A high-temperature resistant polymeric sleeve material comprising a fluoro polymer or an aromatic polymer is known from document D3 (cf. column 2, lines 30-37). The skilled person would therefore regard it as a normal design option to include this feature in the composite conductor described in document D1 in order to solve the problem underlying claims 9 and 10. The subject-matter of claims 9 and 10 does not therefore involve an inventive step.
7. The subject-matter of claims 11, 11' and 12 is known from document D6 (cf. column 4, line 60 - column 5, line 33). The skilled person would therefore regard it as a normal design option to include these features in the composite conductor described in document D1 in order to solve the problems underlying these claims. The subject-matter of said claims does not therefore involve an inventive step.
8. The features introduced by the subject-matter of claim 13 are known from document D1.
9. Document D1 nor any of the other prior art documents show the additional features introduced by claim 14. The subject-matter of claim 14 is therefore new and involves an inventive step.
- 10.1 Document D1, representing the most relevant state of the art, does not disclose a process for making a composite conductor comprising the steps of :
 - gathering together a plurality of strands of conductor material into a conductor bundle and twisting the bundled strands bodily about a longitudinal centerline of the bundle to form a twisted conductor bundle,
 - applying a coating of conductive material to the exterior of the twisted

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- conductor bundle to form a first, inner, corona shield,
- extruding an insulating sleeve of homogeneous polymeric material onto the coating of conductive material on the conductor bundle, the polymeric material having been previously filled with at least one insulating filler material which conducts heat more efficiently than the polymer alone and,
- applying a coating of conductive material to the outer surface of the insulating sleeve to form a second, outer, corona shield; wherein each strand of conductor material is provided with an insulating coating by at least one of coating the strands before the formation of the conductor bundle, and coating the strands during the impregnation step.

10.2 The problem to be solved may therefore be regarded as to provide a process for making a composite conductor with an insulation sleeve resistant against electrical degradation and with reduced winding losses from eddy currents.

None of the available prior art documents discloses or suggests a process comprising the abovementioned steps. The subject-matter of independent claim 15 is therefore novel (Article 33(2) PCT) and involves an inventive step (Article 33(3) PCT).

11. Claims 16-18 are dependent on claim 15. The subject-matter of said claims is therefore also novel and involves an inventive step.
12. The subject-matter of claims 19-20 is known from document D1 (cf. column 1, lines 5-14).
13. Retaining means for retaining the windings in slots are well-known to those skilled in the art (cf. Document D5, figure 1, reference sign 6). The skilled person would therefore regard it as a normal design option to include this feature in the composite conductor described in document D1 in order to solve the problem underlying claim 21. The subject-matter of claim 21 does not therefore involve an inventive step.
14. Document D1 nor any of the other prior art documents show the method of making a stator according to claim 22. The subject-matter of claim 22 is therefore new and involves an inventive step.

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new and involves an inventive step.

15. The present application is susceptible of industrial application in the sense of Article 33(4) PCT.

Re Item VII

Certain defects in the international application

1. Independent claims 1 and 16 are not in the two-part form in accordance with Rule 6.3(b) PCT, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).
2. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).
3. Claims 11'-26 should be renumbered as claims 12-27.
4. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in documents D1, D3, D6 and D7 is not mentioned in the description, nor are these documents identified therein.
5. According to the requirements of Rule 11.13(l) reference signs not appearing in the description shall not appear in the drawings, and vice versa. This requirement is not met in view of the reference signs 16 (wedge) and H (height of insulating sleeve) which appear in the description but not in the figures.

Re Item VIII

Certain observations on the international application

1. According to Rule 6.2(a) PCT, claims should not rely on references to the drawings (see PCT International Preliminary Examination Guidelines, III-4.10). Claims 23-26 solely rely on such references. It is therefore difficult, if not impossible, to determine the matter for which protection is sought by said claims. Claims 23-26 do not meet the requirements of Article 6 PCT.

PATENT COOPERATION TREATY

PCT

**NOTIFICATION OF RECEIPT OF
RECORD COPY**

(PCT Rule 24.2(a))

From the INTERNATIONAL BUREAU

To:

DARGAVEL, Laurence, Peter
Alstom UK Ltd.
Mill Road
P.O. Box 70
Rugby
Warwickshire CV21 1TB
ROYAUME-UNI

Date of mailing (day/month/year) 12 May 2000 (12.05.00)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 70017.WO/LML	International application No. PCT/GB00/01112

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

ALSTOM UK LTD. (for all designated States except US)
GLEW, Charles, Neville (for US)

International filing date : 31 March 2000 (31.03.00)

Priority date(s) claimed : 01 April 1999 (01.04.99)

Date of receipt of the record copy by the International Bureau : 18 April 2000 (18.04.00)

List of designated Offices :

EP :AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE
National :AU,CA,JP,KR,MX,NO,RU,US,ZA

ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- time limits for entry into the national phase
- confirmation of precautionary designations
- requirements regarding priority documents

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer: S. Cruz Telephone No. (41-22) 338.83.38
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Form PCT/I/B/301 (July 1998)

003281032

PATENT COOPERATION TREATY

PCT

NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

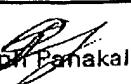
(PCT/Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU

To:

DARGAVEL, Laurence, Peter
Alstom UK Ltd.
Mill Road
P.O. Box 70
Rugby
Warwickshire CV21 1TB
ROYAUME-UNI

Date of mailing (day/month/year) 23 May 2000 (23.05.00)			
Applicant's agent's file reference 70017/WO/LML	IMPORTANT NOTIFICATION		
International application No. PCT/GB00/01112	International filing date (day/month/year) 31 March 2000 (31.03.00)		
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 01 April 1999 (01.04.99)		
Applicant ALSTOM UK LTD. et al			
<p>1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).</p> <p>2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.</p> <p>3. An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.</p> <p>4. The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.</p>			
<u>Priority date</u> 01 April 1999 (01.04.99)	<u>Priority application No.</u> 9907507.7	<u>Country or regional office or PCT receiving Office</u> GB	<u>Date of receipt of priority document</u> 15 May 2000 (15.05.00)

<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Faxsimile No. (41-22) 740.14.35</p>	<p>Authorized officer  Lazar Joseph Panakal</p> <p>Telephone No. (41-22) 338.83.38</p>
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PATENT COOPERATION TREATY

VVO 00/00/21
PCT/GB00/011

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

DARGAVEL, Laurence, Peter
Alstom UK Ltd.
Mill Road
P.O. Box 70
Rugby
Warwickshire CV21 1TB
ROYAUME-UNI

Date of mailing (day/month/year) 12 October 2000 (12.10.00)
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Applicant's or agent's file reference 70017.WO/LML

IMPORTANT NOTICE

International application No. PCT/GB00/01112	International filing date (day/month/year) 31 March 2000 (31.03.00)	Priority date (day/month/year) 01 April 1999 (01.04.99)
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Applicant ALSTOM UK LTD. et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
AU,KR,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
CA,EP,JP,MX,NO,RU,ZA

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
 12 October 2000 (12.10.00) under No. WO 00/60721

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland

Faxsimile No. (41-22) 740.14.35

Authorized officer

J. Zahra

Telephone No. (41-22) 338.83.38

Form PCT/IB/308 (July 1996)

3564945

PATENT COOPERATION TREATY

PCT

**INVITATION TO CORRECT
PRIORITY CLAIM**

(PCT Rules 4.10, 26bis.1, 26bis.2(a) and (b))

From the INTERNATIONAL BUREAU

To:

DARGAVEL, Laurence, Peter
Alstom UK Ltd.
Mill Road
P.O. Box 70
Rugby
Warwickshire CV21 1TB
ROYAUME-UNI

Date of mailing (day/month/year) 18 May 2000 (18.05.00)	
Applicant's or agent's file reference 70017.WO/LML	REPLY DUE See item 1
International application No. PCT/GB00/01112	International filing date (day/month/year) 31 March 2000 (31.03.00)
Applicant ALSTOM UK LTD.	

The applicant is hereby invited, within the time limit indicated below, to correct, by a notice submitted to the International Bureau, defects in the priority claim(s), as indicated in the Annex:

1. Time limit to respond to this invitation (Rule 26bis.1(a)):

- within 16 months from the (earliest) priority date; or
- if the (earliest) priority date is changed as a result of the correction or addition of the (earliest) priority claim, within 16 months from that (earliest) priority date so changed,

whichever expires first, provided that such a notice may, in any event, be submitted until the expiration of four months from the international filing date.

01/08/2000

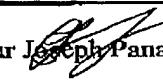
Failure to respond to this invitation within the prescribed time limit may result in the priority claim concerned to be considered, for the purposes of the procedure under the PCT, not to have been made (Rule 26bis.2(b)).

2. In the case where multiple priorities have been claimed, this invitation relates to the following priority claim(s):

Pauline

Please respond by sending a copy of sheet 3 of the Request form with the correct number of the earlier application, plus covering letter,
to →

3. A copy of this invitation is being sent to the receiving Office.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer Lazar Joseph Panakal  Telephone No. (41-22) 338.83.38
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The International Bureau has found the following defects in the priority claim(s):

I. Failure to Comply with the Requirements of Rule 4.10

a. **National application**

- Missing indication of the filing date of the earlier application.
- Filing date indicated for the earlier application does not fall within the period of 12 months preceding the international filing date.
- Missing indication of the number of the earlier application.*
- Missing indication of the country party to the Paris Convention for the Protection of Industrial Property, or of the Member of the World Trade Organization that is not party to that Convention, in which the earlier national application was filed.
- The country indicated is neither a party to the Paris Convention for the Protection of Industrial Property nor a Member of the World Trade Organization.

b. **Regional application**

- Missing indication of the filing date of the earlier application.
- Filing date indicated for the earlier application does not fall within the period of 12 months preceding the international filing date.
- Missing indication of the number of the earlier application.*
- Missing indication of the authority entrusted with the granting of regional patents under the applicable regional patent treaty.
- The authority indicated as the authority entrusted with the granting of regional patents does not grant regional patents.
- The priority claim in relation to the ARIPO application does not indicate either at least one country party to the Paris Convention for the Protection of Industrial Property, or at least one Member of the World Trade Organization, for which the earlier application was filed.

c. **International application**

- Missing indication of the filing date of the earlier application.
- Filing date indicated for the earlier application does not fall within the period of 12 months preceding the international filing date.
- Missing indication of the number of the earlier application.*
- Missing indication of the receiving Office with which it was filed.

2. Inconsistency with the Corresponding Indications in the Priority Document*

a. Inconsistency with regard to the filing date of the earlier application:

The request indicates:

The priority document indicates:

b. Inconsistency with regard to the number of the earlier application:

The request indicates: 99075077

The priority document indicates: 99075277 ← GB 9907527.7

c. Inconsistency with regard to the country party to the Paris Convention for the Protection of Industrial Property or the Member of the World Trade Organization in which the national application was filed:

The request indicates:

The priority document indicates:

d. Inconsistency with regard to the authority entrusted with the granting of regional patents under the applicable regional patent treaty:

The request indicates:

The priority document indicates:

e. Inconsistency with regard to the receiving Office with which the international application was filed:

The request indicates:

The priority document indicates:

* Even if this defect is not corrected in response to this invitation, the priority claim concerned will not be considered not to have been made (Rule 26bis.2(b)).

PATENT COOPERATION TREATY

PCT

**INFORMATION CONCERNING ELECTED
OFFICES NOTIFIED OF THEIR ELECTION**

(PCT Rule 61.3)

From the INTERNATIONAL BUREAU

To:

DARGAVEL, Laurence, Peter
Alstom UK Ltd.
Mill Road
P.O. Box 70
Rugby
Warwickshire CV21 1TB
ROYAUME-UNI

Date of mailing (day/month/year) 23 November 2000 (23.11.00)		IMPORTANT INFORMATION	
Applicant's or agent's file reference 70017.WO/LML			
International application No. PCT/GB00/01112	International filing date (day/month/year) 31 March 2000 (31.03.00)	Priority date (day/month/year) 01 April 1999 (01.04.99)	
Applicant ALSTOM UK LTD. et al			

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

EP :AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE
National :AU,CA,JP,KR,NO,RU,US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

National :MX,ZA

3. The applicant is reminded that he must enter the "national phase" before the expiration of 30 months from the priority date before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

The entry into the European regional phase is postponed until 31 months from the priority date for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer: Juan Cruz Telephone No. (41-22) 338.83.38
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PATENT COOPERATION TREATY

From the:
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

DARGAVEL, Laurence P.
ALSTOM UK LIMITED
PO BOX 70, Mill Road
Rugby Warwickshire CV21 1TB
GRANDE BRETAGNE

PCT

WRITTEN OPINION

(PCT Rule 66)

27-3-01

		Date of mailing (day/month/year)	27.12.2000
Applicant's or agent's file reference P70017.WOP/LML		REPLY DUE	within 3 month(s) from the above date of mailing
International application No. PCT/GB00/01112	International filing date (day/month/year) 31/03/2000	Priority date (day/month/year) 01/04/1999	
International Patent Classification (IPC) or both national classification and IPC H02K3/40			
Applicant ALSTOM UK LTD.			

1. This written opinion is the first drawn up by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

- I Basis of the opinion
- II Priority
- III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV Lack of unity of invention
- V Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI Certain document cited
- VII Certain defects in the international application
- VIII Certain observations on the international application

3. The applicant is hereby invited to reply to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also: For an additional opportunity to submit amendments, see Rule 66.4. For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis. For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 01/08/2001.

Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx. 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer / Examiner van der Haegen, D
	Formalities officer (incl. extension of time limits) Garvey, R Telephone No. +49 89 2399 2271



WRITTEN OPINION

International application No. PCT/GB00/01112

I. Basis of the opinion

1. This opinion has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed"*):

Description, pages:

1-16 as originally filed

Claims, No.:

1-27 as originally filed

Drawings, sheets:

1/4-4/4 as received on 16/06/2000 with letter of 25/05/2000

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: english , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4 The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:

WRITTEN OPINION

International application No. PCT/GB00/01112

the drawings, sheets:

5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c));
(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:**7. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Statement Novelty (N)	Claims
Inventive step (IS)	Claims 1-14, 20-22
Industrial applicability (IA)	Claims

**2. Citations and explanations
see separate sheet****VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. The following documents were cited in the International Search Report, the numbering will be adhered to in the rest of the procedure :

- D1: EP-A-0 266 602 (ASEA AB) 11 May 1988
- D2: EP-A-0 951 132 (ABB RESEARCH LTD) 20 October 1999
- D3: US-A-5 710 475 (BAUMGARTNER CHARLES EDWARD ET AL) 20 January 1998
- D4: EP-A-0 760 282 (KANEYAFUCHI CHEMICAL IND) 5 March 1997
- D5: DE 195 47 229 A (ASEA BROWN BOVERI) 19 June 1997
- D6: US-A-4 008 409 (RHUDY RALPH G ET AL) 15 February 1977
- D7: GB-A-1 526 081 (WESTINGHOUSE ELECTRIC CORP.) 27 September 1978

Document D7 was not cited in the international search report. A copy of the document is appended hereto.

It appears that the priority of the present application is validly claimed. Document D2, cited as a P-document in the search report, does not therefore belong to the state of the art according to Rule 64.1 PCT. Consequently, document D2 will not be referred to in the rest of the procedure.

2. The present application does not meet the requirements of Article 33(3) PCT, because the subject-matter of claim 1 does not involve an inventive step, the reason being as follows :

Document D1, which is considered to represent the most relevant state of the art, discloses (cf. Figure 2) :

- a composite conductor suitable for use as a winding of a high voltage electrical machine (cf. column 2, lines 52-54)
- a plurality of strands (18) of conductor material forming a conductor bundle

(17) which in cross-section is of generally rectangular shape

- the strands (18) being insulated (19) from each other within the bundle (17)
- an insulation sleeve (14) of substantially homogeneous polymeric material (cf. column 3, lines 30-34)
- the insulation sleeve (14) having a generally rectangular shape in cross-section
- the polymeric material being filled with at least one electrically insulating filler material which conducts heat more efficiently than the polymer alone (cf. column 2, lines 1-6)

The subject-matter of claim 1 differs from this disclosure in that conductive material forming a corona shield coating at the inner and outer surfaces of the insulation sleeve is provided.

The problem to be solved by the present invention may therefore be regarded as to prevent electrical degradation of the insulation sleeve due to corona discharges across voids between the conductor material and the insulation sleeve and across voids between the insulation sleeve and the stator slot walls.

However, a solution to this problem has already been proposed in a similar composite conductor, see document D6, column 4, lines 23-28. It would be obvious to the person skilled in the art, namely when the same result is to be achieved, to apply these features with corresponding effect to a composite conductor according to document D1, thereby arriving at a composite conductor according to claim 1. The subject-matter of claim 1 does therefore not involve an inventive step (Article 33(3) PCT).

3. Dependent claims 2-14, 20-22 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, the reasons being as follows:

(i) Rounding the corners of rectangular shaped conductor bundles and insulation sleeves is a measure well-known to those skilled in the art in order to prevent corona discharge at these corners (cf. document D7, page 1, lines 10-22). The solutions provided by subject-matter of claims 2-6 therefore

come within the scope of the customary practice followed by persons skilled in the art. Consequently, the subject-matter of claims 2-6 lacks an inventive step (Article 33(3) PCT).

- (ii) Twisting a conductor bundle around the longitudinal centerline of the bundle in order to reduce losses from eddy currents is a normal design procedure. The subject-matter of claim 7 does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT.
- (iii) The features introduced by the subject-matter of claim 8 are known from document D1 (cf. column 2, lines 1-6).
- (iv) A high-temperature resistant polymeric sleeve material comprising a fluoro polymer or an aromatic polymer is known from document D3 (cf. column 2, lines 30-37). The skilled person would therefore regard it as a normal design option to include this feature in the composite conductor described in document D1 in order to solve the problem underlying claims 9 and 10. The subject-matter of claims 9 and 10 does not therefore involve an inventive step (Article 33(3) PCT).
- (v) The subject-matter of claims 11-13 is known from document D6 (cf. column 4, line 60 - column 5, line 33). The skilled person would therefore regard it as a normal design option to include these features in the composite conductor described in document D1 in order to solve the problems underlying claims 11-13. The subject-matter of claims 11-13 does not therefore involve an inventive step (Article 33(3) PCT).
- (vi) The features introduced by the subject-matter of claim 14 are known from document D1.
- (vii) The subject-matter of claims 20-21 is known from document D1 (cf. column 1, lines 5-14).
- (viii) Retaining means for retaining the windings in slots are well-known to those skilled in the art (cf. Document D5, figure 1, reference sign 6). The skilled

person would therefore regard it as a normal design option to include this feature in the composite conductor described in document D1 in order to solve the problem underlying claim 22. The subject-matter of claim 22 does not therefore involve an inventive step (Article 33(3) PCT).

4. If the applicant considers some particular matter to be new and inventive in view of the disclosures made in documents D1-D7, he is invited to file a new set of claims in order to overcome the above objections. The applicant should also indicate in his letter of reply the difference of the subject-matter of the new claims vis-à-vis the cited prior art documents and the significance thereof. When filing such a new set of claims, the applicant should at the same time remedy the defects listed under Sections VII and VIII.

Re Item VII

Certain defects in the international application

1. Independent claims 1 and 16 are not in the two-part form in accordance with Rule 6.3(b) PCT, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT). If, however, the applicant is of the opinion that the two-part form would be inappropriate, then reasons therefor should be provided in the letter of reply. In addition, the applicant should ensure that it is clear from the description which features of the subject-matter of claims 1 and 16 are already known in combination from the document D1 (see the PCT Guidelines, III-2.3a).
2. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT). The applicant is invited to remove this defect.
3. Claims 12-27 are wrongly numbered as claims 11-26. The applicant is requested to rectify this error.
4. Claims 24-27 contain references to the drawings. According to Rule 6.2(a) PCT, claims should not contain such references.

With his letter of 6 september 2000 the applicant requested the rectification of the objections listed under paragraphs 3 and 4. It appears that this rectification was refused under Rule 91.1(g)(i) PCT by the Receiving Section. However, it occurs to the examiner that the requested corrections are necessary for the application in order to be compliant with the requirements of the PCT. It is therefore suggested that the applicant files a set of amended claims, taking account of these errors.

5. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in documents D1, D3, D6 and D7 is not mentioned in the description, nor are these documents identified therein. The applicant is requested to identify these documents in the description and to briefly discuss the relevant background art disclosed therein.
6. According to the requirements of Rule 11.13(l) reference signs not appearing in the description shall not appear in the drawings, and vice versa. This requirement is not met in view of the reference signs **16** (wedge) and **H** (height of insulating sleeve) which appear in the description but not in the figures.

Re Item VIII

Certain observations on the international application

1. The subject-matter of claim 8 does not meet the requirements of Article 6 PCT. The syntax used in this claim leads to ambiguity i.e. an insulating filler material cannot be a metallic oxide **and** a metallic nitride at one and the same time. It is therefore suggested to remove this defect; an amendment overcoming this objection could read : "... *insulating filler material (...)* **comprising** a metallic oxide **and/or** a metallic nitride."

Amendments

Certain observations on filing amendments

1. The applicant is requested to file the amendments by way of replacement pages in the manner stipulated by Rule 66.8(a) PCT. In particular, fair copies of the amendments should be filed preferably in triplicate.
Moreover, the applicant's attention is drawn to the fact that, as a consequence of

**WRITTEN OPINION
SEPARATE SHEET**

International application No. PCT/GB00/01112

Rule 66.8(a) PCT the examiner is not permitted to carry out any amendments under the PCT procedure, however minor these may be.

2. In order to facilitate the examination of the conformity of the amended application with the requirements of Article 34(2)(b) PCT, the applicant is requested to clearly identify the amendments carried out, no matter whether they concern amendments by addition, replacement or deletion, and to indicate the passages of the application as filed on which these amendments are based (see also Rule 66.8(a) PCT).

If the applicant regards it as appropriate these indications could be submitted in handwritten form on a copy of the relevant parts of the application as filed.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 97/00903

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H02K 3/40, H02K 15/08, H01B 9/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01B, H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4109098 A (MATS GUNNAR OLSSON ET AL.), 22 August 1978 (22.08.78), column 2, line 50 - column 4, line 29, figure 1, abstract	1-4, 7-15
Y	--	16-20
Y	US 4317001 A (DAVID A. SILVER ET AL.), 23 February 1982 (23.02.82), column 2, line 28 - column 3, line 36, figure 1, abstract	16-18
Y	--	
Y	US 3891880 A (HELMUT BRITSCH), 24 June 1975 (24.06.75), column 4, line 28 - line 57, figure 2, abstract	19-20
	--	

 Further documents are listed in the continuation of Box C. See patent family annex.

- * Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

2 Sept 1997

04-09-1997

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM

Authorized officer

Karin Säfsten

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 97/00903

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0049104 A1 (BICC LIMITED), 7 April 1982 (07.04.82), abstract -----	1-21

INTERNATIONAL SEARCH REPORT

Information on patent family members

06/08/97

International application No.

PCT/SE 97/00903

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 4109098 A	22/08/78	AR 211382 A AU 7707175 A BE 825068 A BR 7500229 A CA 1038052 A CH 587545 A DE 2501811 A FR 2260173 A,B GB 1493163 A JP 50109479 A NL 7501168 A SE 384420 B,C SE 7401244 A		15/12/77 08/07/76 15/05/75 04/11/75 05/09/78 13/05/77 14/08/75 29/08/75 23/11/77 28/08/75 04/08/75 03/05/76 01/08/75
US 4317001 A	23/02/82	AR 222689 A BR 8001105 A DE 3001647 A FR 2449953 A,B GB 2043078 A,B JP 55149348 A SE 445789 B,C SE 8001418 A US 4384944 A		15/06/81 29/10/80 04/09/80 19/09/80 01/10/80 20/11/80 14/07/86 24/08/80 24/05/83
US 3891880 A	24/06/75	AT 328548 B BR 7304445 D CH 547028 A DE 2233204 A,C FR 2189840 A,B GB 1430832 A SE 395802 B,C		25/03/76 00/00/00 15/03/74 03/01/74 25/01/74 07/04/76 22/08/77
EP 0049104 A1	07/04/82	GB 2084385 A,B		07/04/82

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/01112

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H02K3/40 H02K3/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 266 602 A (ASEA AB) 11 May 1988 (1988-05-11) abstract	1
Y		2-6
Y, P	EP 0 951 132 A (ABB RESEARCH LTD) 20 October 1999 (1999-10-20) figures	2-6
X	US 5 710 475 A (BAUMGARTNER CHARLES EDWARD ET AL) 20 January 1998 (1998-01-20) column 2, line 9 -column 3, line 2	1,8-10
(EP 0 760 282 A (KANEKAUCHI CHEMICAL IND) 5 March 1997 (1997-03-05) abstract page 3, column 26, line 3 -page 4, column 16	1,8-13
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- *'1" document defining the general state of the art which is not considered to be of particular relevance
- *'2" earlier document but published on or after the International filing date
- *'3" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *'4" document referring to an oral disclosure, use, exhibition or other means
- *'5" document published prior to the International filing date but later than the priority date claimed

- *'T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *'X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *'Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *'8" document member of the same patent family

Date of the actual completion of the international search

30 June 2000

Date of mailing of the international search report

06/07/2000

Name and mailing address of the ISA

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Ramos, H

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/01112

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		Relevant to claim No.
Category	Citation of document, with indication, where appropriate, of the relevant passages	
A	DE 195 47 229 A (ASEA BROWN BOVERI) 19 June 1997 (1997-06-19) abstract	
A	US 4 008 409 A (RHUDY RALPH G ET AL) 15 February 1977 (1977-02-15) column 6, line 38 -column 6, line 43	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 00/01112

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0266602 A	11-05-1988	SE 455246 B AT 85474 T CA 1289610 A DE 3784008 A DE 3784008 T JP 63110929 A SE 8604509 A US 4806806 A	27-06-1988 15-02-1993 24-09-1991 18-03-1993 24-06-1993 16-05-1988 23-04-1988 21-02-1989
EP 0951132 A	20-10-1999	DE 19817287 A CN 1233101 A JP 11332154 A	21-10-1999 27-10-1999 30-11-1999
US 5710475 A	20-01-1998	NONE	
EP 0760282 A	05-03-1997	WO 9626973 A CA 2185337 A CN 1152275 A WO 9626833 A	06-09-1996 06-09-1996 18-06-1997 06-09-1996
DE 19547229 A	19-06-1997	NONE	
US 4008409 A	15-02-1977	BR 7602220 A ES 446814 A	05-10-1976 01-06-1977

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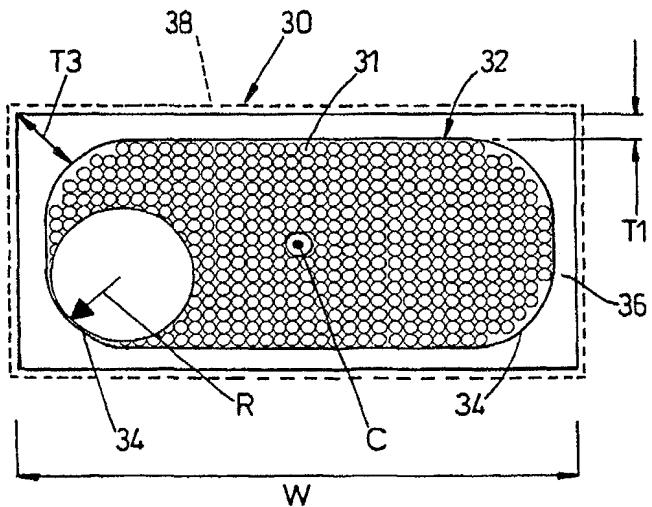
WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : H02K 3/40, 3/30		A1	(11) International Publication Number: WO 00/60721 (43) International Publication Date: 12 October 2000 (12.10.00)
(21) International Application Number: PCT/GB00/01112		(81) Designated States: AU, CA, JP, KR, MX, NO, RU, US, ZA, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).	
(22) International Filing Date: 31 March 2000 (31.03.00)		Published <i>With international search report.</i> <i>With amended claims.</i>	
(30) Priority Data: 9907527.7 1 April 1999 (01.04.99) GB			
(71) Applicant (for all designated States except US): ALSTOM UK LTD. [GB/GB]; Mill Road, P.O. Box 70, Rugby, Warwickshire CV21 1TB (GB).			
(72) Inventor; and			
(75) Inventor/Applicant (for US only): GLEW, Charles, Neville [GB/GB]; 4 Drayton Leys, Rugby, Warwickshire CV22 SRH (GB).			
(74) Agent: DARGAVEL, Laurence, Peter; Alstom UK Ltd., Mill Road, P.O. Box 70, Rugby, Warwickshire CV21 1TB (GB).			

(54) Title: IMPROVEMENTS IN ELECTRICAL MACHINES



(57) Abstract

A composite conductor (30) comprises strands (31) of conductor material forming a conductor bundle (32) of generally rectangular shape, the strands being insulated from each other within the bundle. An insulating sleeve (36) of homogeneous polymeric material surrounds the conductor bundle (32); the insulating sleeve also having a rectangular shape. The polymeric material of the sleeve is filled with at least one insulating filler material which conducts heat more efficiently than the polymer alone, and a coating of conductive material (38) forms a corona shield on the inner and outer surfaces of the insulating sleeve. By virtue of its construction and the materials it uses, the composite conductor (30) provides a high efficiency winding (46) for the stator (40) of an electrical machine. The invention also includes a stator having a winding comprising the composite conductor and manufacturing methods for the composite conductor and the stator.

FOR THE PURPOSES OF INFORMATION ONLY

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EE	Estonia						

- 1 -

IMPROVEMENTS IN ELECTRICAL MACHINES

This invention relates to electrical machines and in particular to insulated electrical conductors suitable for use as excitation windings on the stators of high voltage
5 electrical machines, for example, machines operating at voltages greater than 3KV.

Known types of excitation winding for the stators of such machines generally comprise solid rectangular copper conductors which are electrically insulated from each other and from an earthed laminated steel core on which they are wound. Materials used to
10 insulate the conductors are chosen so as to have properties - such as thickness, thermal conductivity, dielectric strength, and permittivity - which are appropriate to the size of the machine, applied voltage and temperature rise.

The power output of a rotating electrical machine (whether a motor or a generator) is
15 a function of the properties of the laminated magnetic steel core, the excitation windings and their operating temperature. An "*output coefficient*" or "*specific torque coefficient*" of such machines is often quoted as a useful means of comparing the power outputs of machines of differing design. Its units are torque per unit volume and it may be derived by dividing the machine's power output by the volume of the stator
20 within the air-gap periphery.

Having been the subject of industrial manufacture for over 100 years, rotating electrical machines are considered a mature product using mature technologies. Over the century of production the materials and processes used in the construction have
25 evolved slowly resulting in a steady increase in output coefficient (about 3.0% per annum) for the most popular machines. Recently, their evolutionary progress has slowed down and has now reached a plateau, suggesting that further development is either unlikely or will be very slow.

- 2 -

It is necessary to externally insulate the stator windings of such machines from each other and the stator core. It is also necessary to internally insulate the windings by insulating the conductors from each other within the winding. The insulation materials presently used to perform the insulation function have only limited ability to withstand
5 high temperatures, with modest electric strength properties and generally poor thermal conductivity. Furthermore, during operation of the machines, heat is generated due to electrical losses in the winding conductors, but the poor thermal conductivity of the insulation materials results in poor transfer of the heat, and this in turn inhibits the output coefficients of the machines on which the insulation materials are used.

10

Since there are only small differences between the stator winding insulation systems used currently by leading manufacturers of machines, the thermal and dielectric performance of such systems is similar. Typically, all use combinations of mica, polyester film and woven glass materials impregnated with synthetic resins. The mica is
15 used in the form of a so-called "paper" which is supported by either polyester film or woven glass and is wrapped around the conductors to insulate them from external contact. To complete the insulation process, they are vacuum pressure impregnated with the synthetic resin (for example, an epoxide resin) as the last process after positioning the windings into the stator.

20

It is an object of the present invention to improve the output coefficients of electrical machines and hence reduce their capital cost per KW output of electrical energy by increasing the heat transfer capability of their stator conductor windings. This is achieved in the invention by means of a novel type of composite conductor.

25

According to the present invention, a composite conductor for use as a winding of a high voltage electrical machine comprises:

a plurality of strands of conductor material forming a conductor bundle which in cross-section is of generally rectangular shape, the strands being insulated from each
30 other within the bundle,

an insulating sleeve of substantially homogeneous polymeric material surrounding the conductor bundle; the insulating sleeve also having a generally rectangular shape in cross-section and the polymeric material being filled with at least one electrically insulating filler material which conducts heat more efficiently than the
5 polymer alone, and

conductive material forming a corona shield coating at the inner and outer surfaces of the insulating sleeve.

The conductor bundle is impregnated with a curable high-temperature resistant
10 insulating material, such as a synthetic resin or polymer material, whereby the cured composite conductor is rendered sufficiently strong and rigid to enable its use in the windings of electrical machines.

It should be noted that the term "rectangular" as used herein includes shapes which are
15 square (having four sides all of substantially equal dimensions) and rectangles and squares having rounded corners.

A composite conductor in accordance with the invention, by virtue of its construction and the materials it uses, provides a high efficiency winding for the stator of an
20 electrical machine. Due to its filler material(s), the insulating sleeve not only has superior dielectric strength properties which permits operating at reduced sleeve wall thickness and/or increased electric stress, but also has much higher thermal conductivity and thermal capability (temperature resistance) than known windings. The higher thermal conductivity permits a considerable increase in the heat transfer
25 capability from the composite conductor into the stator core, which may be cooled by heat exchange with ducted airstreams. Furthermore, insulation of the conductor strands from each other substantially reduces high frequency eddy current losses in the stator winding, and the conductive surface coating on the insulation sleeve contributes to enabling safe operation at higher electric stresses at the surface of the sleeve. The

net result of the above is that the output coefficient is substantially increased and hence the capital cost of the delivered power is substantially decreased.

Preferably, the corners of the conductor bundle's rectangular shape are radiused to
5 minimise electrical stress concentrations. The radius dimension may be up to 5 mm.,
preferably between 2-3 mm., but it is preferred that the corners of the insulating sleeve
are substantially rectilinear, having a radius of not more than about 1mm.

Preferably, the strands of conductor material are collectively twisted around the
10 longitudinal centreline of the conductor bundle in a similar manner to which the strands
in a rope are twisted about the longitudinal centreline of the rope. This angular/spatial
transposition of the strands of conductor material longitudinally of the bundle due to
its twist inherently cancels eddy currents as they arise, substantially reducing or
eliminating the associated losses.

15 The at least one insulating filler material in the polymer insulating sleeve is preferably a
metallic oxide and/or a metallic nitride.

The polymeric sleeve material preferably comprises a high temperature polymer, e.g. a
20 polymer selected from the groups comprising fluoropolymers or aromatic polymers,
and the conductive coating material for reducing electric stress variations at the
surfaces of the composite conductor may comprise a graphitic or silicon-based
material, preferably a high-temperature resistant polymer or paint material which has
sufficient of the conductive material incorporated therein to render it conductive.

25 Preferably the strands of conductor material comprise copper, but other materials may
be useable, such as aluminium or silver. Whatever the material from which the
conductor strands are made, it is preferred they are insulated from each other by means
of a coating of high-temperature resistant synthetic resin or polymer material on each
30 strand. This may be achieved either by impregnation of the conductor bundle with a

resin or precursor polymer material in its uncured state, or perhaps more conveniently and reliably by using conductor strands that have been previously manufactured with an insulating coating before being incorporated into the conductor bundle. Both these conductor coating techniques are well known in the art.

5

The invention further envisages a process for making the above composite conductor, comprising the steps of:

gathering together a plurality of strands of conductor material to form a conductor bundle,

10 impregnating the conductor bundle with a curable high-temperature resistant insulating material, the impregnation occurring one of simultaneously with the gathering process and subsequent thereto,

applying a coating of conductive material to the exterior of the twisted conductor bundle to form a first, inner, corona shield,

15 extruding an insulating sleeve of homogeneous polymeric material onto the coating of conductive material on the conductor bundle, the polymeric material having been previously filled with at least one insulating filler material which conducts heat more efficiently than the polymer alone, and

20 applying a coating of conductive material to the outer surface of the insulating sleeve to form a second, outer, corona shield;

wherein each strand of conductor material is provided with an insulating coating by at least one of coating the strands before the formation of the conductor bundle, and coating the strands during the impregnation step.

25 We prefer that the conductor bundle is formed into a generally rectangular shape during or subsequent to the gathering process. We further prefer that subsequent to the formation of the conductor bundle, the bundled strands are twisted bodily about a longitudinal centreline of the bundle to form a twisted conductor bundle.

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Whereas it is known to impregnate the insulating wrappings of bar conductor windings with synthetic resin after they have been assembled onto the stator, then partially or wholly to cure the resin, it is envisaged that in the present invention, impregnation occurs before the composite conductor is wound onto the stator, the composite conductor then being wound onto the stator while the resin or precursor polymer material is uncured or only partly cured. This facilitates the impregnation process while allowing easy manipulation of the composite conductor during the stator winding process before the resin is fully cured.

5

10 The invention also includes a stator for a rotary electrical machine comprising a laminated steel core provided with a plurality of radially oriented slots extending longitudinally of the stator, each slot housing a winding comprising either a plurality of turns of a single length of the above composite conductor, or a plurality of turns comprising a plurality of lengths of the above composite conductor, successive turns of the composite conductor being in contact and in radial registration with each other.

15

20 The winding is retained in its slot, preferably by a high thermal conductivity, electrically insulating retaining means fixed in the radially outer end of the slot. Preferably, the retaining means is a filled polymer composition having relatively high thermal conductivity compared to the polymer in its unfilled state.

25

It should be understood that the materials mentioned herein in connection with composite conductors according to the invention are best estimates of which materials will probably be suitable.

Exemplary embodiments of the invention will now be described with reference to the accompanying drawings, in which:

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Figure 1 is a perspective view of part of the inside of a stator of a rotary electrical machine provided with a conventional winding;

Figure 2 is a cross-section of a composite conductor according to the present invention;

5 Figure 3 is a cross-section of an alternative composite conductor according to the present invention;

Figure 4 is a radial section through part of a stator according to the invention, showing a stator slot containing a winding comprising six turns of the composite conductor shown in Figure 2;

10 Figure 5 is a diagrammatic representation of a process for manufacturing a composite conductor according to the invention.

Referring to Figure 1, there is shown the inner circumference of one end of a stator 10 of an A.C. electrical machine. The stator is intended to encircle the rotor (not shown) 15 of the electrical machine. As is conventional, the stator body is composed of a large number of steel laminations and is formed with a large number of radially oriented slots 12 which extend longitudinally of the stator body.

Each slot 12 houses an excitation winding 14, successive "turns" 14A, 14B of which 20 contact each other and are in radial registration within their slot. The windings are retained in their slots by wedges 16, made of a suitable polymer insulation material, such as filled epoxide resin. During manufacture of the stator, wedges 16 are forced into position within the mouths of the slots 12.

25 The loops or "turns" of the windings each comprise solid rectangular copper conductor bars 14A, 14B which are pre-formed to the correct shape to enable their installation into the stator slots. The conductor bars are electrically insulated from each other and from the earthed steel core by wrappings of mica paper on polyester support film, the wrappings being pressure-impregnated with epoxide resin and cured later.

To enable the construction of the stator winding 14 from pre-formed lengths of conductor bar, each turn of the winding consists of a plurality of lengths of conductor bar whose ends 15 projecting from the stator core are bent at compound angles as shown, these ends being brazed or otherwise securely joined together in electrical contact (not shown) to complete the turn. The ends of radially adjacent conductor bars 14A, 14B are bent in opposing directions.

As Figure 1 shows, where the ends of the conductor bars 14A, 14B, etc., project from the ends of the slots 12, packing blocks 18, 20 are inserted between adjacent conductor bars, packing blocks 18 being adjacent the end of the stator core and packing blocks 20 being spaced away from the stator core. Various of the packing blocks 18, 20 and the bent portions of some of the conductor bars 14A and 14B have been removed at the lower left of Figure 1 to show the construction more clearly. The packing blocks are moulded to shape, being made up from glass cloth bags containing glass mat laminate filler pieces impregnated with epoxide resin. Packing blocks 20 are bound to the adjacent conductor bars with glass fibre tape 22.

After assembly of the stator winding and insertion of the packing blocks, assembly of the stator is completed by tying the bent portions 15 of the conductor bars 14A, 14B, to support rings 24, 26 using glass fibre cord 28. The packing blocks and the support rings provide support to the ends of the conductor bars and prevent vibration during service. Finally, the stator assembly is heat-treated at an appropriate curing temperature for its resin-impregnated portions, this temperature being below that which would cause deterioration of the polyester film component of the conductor wrappings.

Turning now to Figure 2, a composite conductor 30 is shown in cross-section and is intended to be used as a stator winding of a high voltage electrical machine, thereby substituting for the wrapped solid conductor bars 14A, 14B of Figure 1. Unlike the solid conductor bars, however, the core of composite conductor 30 comprises a large

number of strands 31 of conductor material forming a conductor bundle 32. Preferably, the strands 31 of conductor material comprise copper, but other materials may be useable, such as aluminium (cheaper, but not such a good electrical conductor as copper) or silver (expensive, but a better electrical conductor). A typical dimension for 5 an individual strand of conductor material is likely to be of the order of 0.1mm, so it will be appreciated that the number of strands 31 needed to form a conductor bundle 32 is likely to be much larger than that diagrammatically indicated in Figure 2, and their cross-sections will consequently appear smaller relative to the total cross-section of the composite conductor 30.

10

Conductor bundle 32, although of generally rectangular shape, has rounded corners 34 to minimise electrical stress concentrations during operation of the electrical machine. The dimensions of the conductor bundle's corner radii R are in the range 0.5 to 5 mm.; 2-3 mm. may be optimum.

15

To reduce high frequency eddy current losses in the stator winding, the bundle of copper strands 32 is bodily twisted around the longitudinal centreline C of the composite conductor 30 in a similar manner to which the fibres in a rope are twisted about the longitudinal centreline of the rope. It should be noted that the spatial 20 transposition of the strands of conductor material longitudinally within the bundle due to its twist inherently cancels eddy currents as they arise.

An insulating sleeve 36 of high temperature polymer material (e.g., a fluoropolymer or an aromatic polymer) surrounds the conductor bundle. In accordance with the 25 invention, the polymer is homogeneously filled with an insulating material which conducts heat more efficiently than the polymer alone. This is explained further below. The insulating sleeve has a rectangular shape in cross-section, but unlike the shape adopted for the conductor bundle, it is preferred that the corners of the insulating sleeve are not substantially rounded, i.e. the long and short sides of the insulating 30 sleeve meet substantially at right angles. However, there may be a small radius present,

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say up to about 1mm., due to the manufacturing process and the need to apply a corona shield coating evenly to the surface of the insulation sleeve. The total width W and height H of the insulating sleeve 36 is substantially uniform in the lateral and lengthwise directions of the composite conductor. The sleeve's wall thickness T1 is 5 similarly uniform, except of course in the regions adjacent the rounded corners 34 of the conductor bundle 32.

Thickness T1 should ideally be as small as possible consistent with adequate electrical insulation properties, because a thin wall for the sleeve 36 enables more rapid 10 conduction of heat away from the bundle of conductor strands 32 and also allows a larger conductor bundle to be included in the composite conductor for the same overall size of composite conductor. The latter point is illustrated by reference to Figure 3, which shows an alternative embodiment of the invention in which the thickness T2 of the sleeve is about twice that of thickness T1 in Figure 2. It will be noticed that the 15 number of conductor strands 31 that can be included in the composite conductor is much less in Figure 3 than in Figure 2.

Ordinary polymer sleeves for electric cables are extruded onto the conductor or conductor bundle by means of an extrusion head through the centre of which runs the 20 conductor to which the sleeve is applied. This is a well known and understood process. A polymer sleeve having a wall thickness of about 0.1mm can be produced by known extrusion processes and it is preferred that the thickness of the polymer sleeve in the invention (excluding the corner regions) should be in the range 0.4 to 2.00mm. For example, a typical value for T1 could be about 0.5mm, preferably 0.65mm, and a 25 typical value for T2 could be about 1mm.

In order to permit operation of the composite conductor 30 with as small a value of T1 as possible, the invention provides that the polymeric material from which the sleeve 30 is made is homogeneously compounded with one or more powdered materials 30 which conduct heat more efficiently than the polymer alone. These materials may be

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metallic oxide or metallic nitride fillers, such as aluminium oxide or aluminium nitride. As a result, the insulating sleeve 36 not only has superior dielectric strength properties which permits operating at reduced thickness, but also has much higher thermal conductivity and temperature resistance than known windings. The approximate 5 volume ratio of polymer to filler material may be 10% to 75%.

To obtain low eddy current losses and hence good electrical efficiency of the composite conductor 30 in its role as a current carrying stator winding in an electrical machine, the individual conductor strands 31 in the conductor bundle 32 are insulated 10 from each other according to the invention. As discussed in more detail below, this can be achieved by impregnating the conductor bundle with a synthetic resin material, such as an epoxide resin, and/or using conductor strands that have been previously provided with an insulating coating. Such pre-coated wires are routinely used in the production of windings for small electrical machines, being wound straight onto a rotor or stator.

15 Before or during the application of the insulating sleeve to the conductor bundle a thin coating of conductive material e.g., a graphitic or silicon-based material, such as a carbon-filled high-temperature resistant polymer, is applied so as to form a corona protective shield on the inside surface of the of the extruded polymer, i.e., at the 20 interface between the insulating sleeve and the conductor bundle. During or after the application of the insulating sleeve to the conductor bundle, a thin coating of the same or a similar conductive material is applied to the outside surface of the insulating sleeve so as to form a corona protective shield thereon. The external coating is indicated by 25 the dotted line 38 surrounding the sleeve 36 in Figure 2 (the inner corona shield is not shown). The purpose of the conductive coating material is to equalise the electric stresses on the surface of the composite conductor during operation of the electrical machine and thereby avoid localised breakdown of the insulation afforded by the insulating sleeve 36. We have found that both inside and outside surfaces of the insulating sleeve should be provided with the conductive corona shield coating to

provide good equalisation of the electric stresses at the surface of the composite conductor.

A suitable thickness for the inner and outer corona shields is in the range about 0.1 to
5 0.3mm, preferably at the lower end of this range. As already stated, a polymer film of this thickness is known to be extrudable and therefore the inner and outer corona shields may be applied by means of extrusion, as hereafter described. Alternatively, the inner corona shield may be applied by winding a thin tape of the conductive material onto the conductor bundle before the insulating sleeve is applied thereto and the outer
10 corona shield may be applied by winding a thin tape onto the outside of the insulating sleeve after the insulating sleeve has been applied to the conductor bundle. As yet a further alternative, the corona shields may be applied in the manner of a coat of paint; for instance, before application of the insulating sleeve to the conductor bundle, the latter may pass through a bath of the corona shield material held as a suspension or
15 solution in a suitable liquid and after the insulating sleeve has been applied it may similarly be passed through such a bath. However, in such a process it will be necessary to ensure that the inner corona shield has adequately dried or cured to form a flexible high temperature resistant coating before application of the insulating sleeve to the conductor bundle occurs. Similarly, the outer corona shield coating must have
20 dried or cured to form a flexible high temperature resistant coating before further handling of the composite conductor occurs, such as winding it into the slots of the electrical machine.

To facilitate the impregnation process while allowing easy manipulation of the composite conductor during the process of producing the winding on the stator core,
25 the composite conductor is impregnated before the composite conductor is wound onto the stator and fully cured only after it has been wound onto the stator. As explained later, impregnation may occur at the time when the individual strands of conductor material are gathered together and consolidated into the conductor bundle,
30 before application of the insulating sleeve. We prefer then to partially cure the resin, so

that the composite conductor is still flexible enough to be wound directly onto the stator, with optional intervening storage on a drum for later use. The completed stator is heat-treated at a temperature below that at which deterioration of the filled polymer sleeve and the corona shield occurs, thereby fully curing the resin to make the finished
5 stator winding rigid.

Turning now to Figure 4, it is shown how the composite conductor 30 of Figure 2 may be used to form a complete stator winding. The stator 40 of a rotary electrical machine comprises a laminated steel core 42 provided with radially oriented slots extending
10 longitudinally of the stator. In the broken-away sectional view, only one of the slots 44 is shown. It houses a winding 46 comprising a plurality of turns or loops of the composite conductor 30. Each turn conveniently comprises a single length of the composite conductor, or alternatively, two or more shorter lengths of composite conductor may be spliced together to complete one turn. As can be seen, successive
15 turns 30A, 30B, etc, of the composite conductor are in contact and in radial registration with each other. It should be noted that the rectangular shape of the composite conductor minimises air voids in the finished winding, enabling geometrically exact production of the winding without pre-forming of rigid bar conductors, as was necessary in the prior art. The winding is retained in its slot 44 by a
20 high thermal conductivity, electrically insulating retaining wedge 48 fixed in the radially outer end of the slot. The wedge may be an extrusion comprising a filled polymer material, such as an epoxide resin, and may be driven into the slot from the end face of the stator.
25 In connection with the rectangular shape of the conductor bundle and the insulating sleeve, it should be particularly noted that besides the better packing characteristics of the composite conductors in the machine slots, the extra thickness T3-T1 (Figure 2) of the insulation at the corner of the conductor bundle effectively reduces the electric stress at the corner to approximately the same value as that on the flat sides of the

conductor bundle. Such reduction in peak electric stresses in the windings contributes to an ability of the machine to operate at higher loadings.

During production of the stator, the inherent flexibility provided by the polymer insulation sleeve, the thin corona shield coatings, the thin conductor strands and the uncured or partially cured resin on the conductor strands, permits ease of positioning of the conductor in the slots in the stator core to form a winding. However, after heat-treatment to cure the resin (curing being at a temperature lower than the temperature at which the filled polymer insulation sleeve and the corona shield coatings begin to deteriorate), the rigidity provided by the fully cured resin on the conductor strands enables the finished stator winding to withstand the operational impressed forces. Note that where the composite conductor winding 30 is not within the slots 44, it may be supported by support rings and packing blocks as shown for the known arrangement in Figure 1.

A possible process for making the composite conductor will now be described with reference to Figure 5. At the left of Figure 5, many pre-insulated wire strands 31 of copper or other conductor material are drawn together from storage reels (not shown) and passed through a bundle forming head I to produce a conductor bundle 32. Within the head I are means, well known in the art of cable-making, whereby the strands 31 are brought together, formed into a bundle and the bundle is bodily twisted around the centreline of the bundle. At the same time as the strands 31 are being formed into a bundle, the bundle is impregnated with an epoxy resin or similar binding and strengthening agent resistant to high temperatures; alternatively, this impregnation process may be a pressure impregnation process, as known, the pressure impregnation being accomplished immediately after the conductor bundle has been formed and either within the head I or following it. The final process within head I (which may in practice be carried out in a separate head, not shown) is to finally form and consolidate the conductor bundle into the required rectangular shape of the present invention by passing it through a suitably shaped die.

The head I is heated so as to partially cure the resin as the conductor bundle passes therethrough, thereby producing a conductor bundle which has good cohesion, yet is still sufficiently flexible to be wound onto a large diameter storage drum S1 for later 5 use. Alternatively, the partly cured bundle passes straight on as indicated through the centre of an annular die in extruding head II, whereby a conductive filled polymer film is extruded onto the outside of the conductor bundle 32 to form a first, inner, corona shield. Thereafter, the coated conductor bundle passes through the centre of a further annular die in extruding head III, whereby a filled polymer insulating sleeve is extruded 10 onto the outside of the first corona shield. Effectively, this first corona shield thereby forms a conductive coating on the inner surface of the insulating sleeve. Finally, by a similar process to that described for head II, a second, outer, corona shield is applied to the insulating sleeve in extruding head IV, so completing the formation of a composite conductor 30. The composite conductor 30 can then be wound onto a large 15 diameter storage drum S2 for later use. Alternatively, as indicated by the dashed arrow line, it can pass straight into a further manufacturing stage for producing windings for electrical machines. As mentioned previously, final curing of the conductor bundles is accomplished by heating, after the composite conductor has been fixed into the winding slots in an electrical machine, as shown in Figure 4.

20

It has been said above that the wire strands 31 are pre-insulated, meaning that during their manufacture they have been provided with a thin coating of suitable epoxy resin or high temperature resistant polymer, as known. However, as an alternative to the use of pre-insulated wire strands, it may be possible to rely on the resin impregnation 25 process which occurs in head I to insulate the strands 31 from each other within the finished conductor bundle. This will be a matter for determination by routine experimentation.

Although in Figure 5 the strands are shown being gathered together into a bundle in a 30 one-stage process, in practice, due to the large number of strands required to make a

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conductor bundle, this first part of the process may require a number of parallel stages in which a number of sub-bundles are produced in corresponding bundle-producing heads, each bundle having been impregnated with resin therein as described previously, the sub-bundles then being brought together to form the final twisted rectangular
5 conductor bundle 32.

It will be evident that the above process may be used to produce composite conductors having cross-sectional shapes other than rectangular, e.g. circular.

CLAIMS

1. A composite conductor for use as a winding of a high voltage electrical machine, comprising:

5 a plurality of strands of conductor material forming a conductor bundle which in cross-section is of generally rectangular shape, the strands being insulated from each other within the bundle,

10 an insulating sleeve of substantially homogeneous polymeric material surrounding the conductor bundle; the insulating sleeve also having a generally rectangular shape in cross-section and the polymeric material being filled with at least one electrically insulating filler material which conducts heat more efficiently than the polymer alone, and

15 conductive material forming a corona shield coating at the inner and outer surfaces of the insulating sleeve.

15

2. A composite conductor according to claim 1, the corners of the conductor bundle's rectangular shape being radiused to minimise electrical stress concentrations.

20

3. A composite conductor according to claim 2, the radius dimensions of the corners of the conductor bundle being up to about 5 mm.

4. A composite conductor according to claim 3, the radius dimensions being between 2-3 mm.

25

5. A composite conductor according to any preceding claim, the corners of the insulating sleeve being substantially rectilinear.

6. A composite conductor according to claim 5, the corners of the insulating sleeve having a radius of not more than about 1mm.

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7. A composite conductor according to any preceding claim, the strands in the bundle of conductor material being collectively twisted around the longitudinal centreline of the conductor bundle, thereby to reduce winding losses from eddy currents.

5

8. A composite conductor according to any preceding claim, that at least one insulating filler material in the polymer insulating sleeve being a metallic oxide and/or a metallic nitride.

10 9. A composite conductor according to any preceding claim, the polymeric sleeve material comprising a high-temperature resistant polymer.

10. A composite conductor according to claim 9, the polymeric sleeve material comprising a fluoropolymer or an aromatic polymer.

15

11. A composite conductor according to any preceding claim, the conductive coating material comprising a graphitic or silicon based material.

20 11. A composite conductor according to claim 11, the conductive coating material comprising a high-temperature resistant polymer or paint material which has sufficient of the conductive material incorporated therein to render it conductive.

12. A composite conductor according to claim 11 or claim 12, the conductive coating material being an extruded film.

25

13. A composite conductor according to any preceding claim, the conductor strands being insulated from each other by means of a high-temperature resistant insulating coating applied to each strand during manufacture of the strands before their incorporation into the conductor bundle.

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14. A composite conductor according to any one of claims 1 to 13, the conductor strands being insulated from each other by means of impregnation of the conductor bundle with a curable high-temperature resistant insulating material during incorporation of the strands into the conductor bundle.

5

15. A process for making a composite conductor, comprising the steps of:
gathering together a plurality of strands of conductor material into a conductor bundle and twisting the bundled strands bodily about a longitudinal centreline of the bundle to form a twisted conductor bundle,

10 impregnating the conductor bundle with a curable high-temperature resistant insulating material, the impregnation occurring one of simultaneously with the gathering and twisting process and subsequent thereto,

 applying a coating of conductive material to the exterior of the twisted conductor bundle to form a first, inner, corona shield,

15 extruding an insulating sleeve of homogeneous polymeric material onto the coating of conductive material on the conductor bundle, the polymeric material having been previously filled with at least one insulating filler material which conducts heat more efficiently than the polymer alone, and

20 applying a coating of conductive material to the outer surface of the insulating sleeve to form a second, outer, corona shield;

 wherein each strand of conductor material is provided with an insulating coating by at least one of coating the strands before the formation of the conductor bundle, and coating the strands during the impregnation step.

25 16. A process according to claim 16, in which after twisting of the bundle, the bundle is formed to a predetermined cross-sectional shape.

17. A process according to claim 17, in which the predetermined cross-sectional shape is rectangular.

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18. A process according to any one of claims 16 to 18, in which the impregnated conductor bundle is partially cured before the coating of conductive material is applied to the outside of the conductor bundle.

5 19. A stator for a rotary electrical machine, comprising a laminated steel core provided with a plurality of radially oriented slots extending longitudinally of the stator, each slot housing a winding comprising a plurality of turns of a single length of a composite conductor constituted according to claim 1, successive turns of the composite conductor being in contact and in radial registration with each other.

10 20. A stator for a rotary electrical machine, comprising a laminated steel core provided with a plurality of radially oriented slots extending longitudinally of the stator, each slot housing a winding comprising a plurality of turns comprising a plurality of lengths of a composite conductor constituted according to claim 1, successive turns of the composite conductor being in contact and in radial registration with each other.

15 21. A stator according to claim 20 or claim 21, the winding being retained in its slot by a high thermal conductivity, electrically insulating retaining means fixed in the radially outer end of the slot.

20 22. A method of making a stator constituted according to claim 21 or claim 22, in which the conductor bundle has been impregnated with a curable high-temperature insulation material and is wound onto the stator core while the curable high-temperature insulation material is only partly cured, attaching support means to the composite conductor where it is unsupported by the stator slots, and heat treating the completed stator to cure the curable high-temperature insulation material and produce a rigid stator winding.

25 30 23. A composite conductor substantially as described herein, with reference to Figures 2 to 4 of the accompanying drawings.

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24. A method of manufacturing a composite conductor substantially as described herein, with reference to Figures 2 to 5 of the accompanying drawings.
- 5 25. A stator for a rotary electrical machine substantially as described herein, with reference to Figure 4 of the accompanying drawings.
26. A method of manufacturing a stator for a rotary electrical machine substantially as described herein, with reference to Figure 4 of the accompanying drawings.

AMENDED CLAIMS

[received by the International Bureau on 6 September 2000 (06.09.00);
original claims 24-26 cancelled; original claim 8 amended;
claims 11-22 renumbered as claims 12-23 other claims unchanged (3 pages)]

7. A composite conductor according to any preceding claim, the strands in the bundle of conductor material being collectively twisted around the longitudinal centreline of the conductor bundle, thereby to reduce winding losses from eddy currents.

5

8. A composite conductor according to any preceding claim, the at least one insulating filler material in the polymer insulating sleeve being a metallic oxide and/or a metallic nitride.

10 9. A composite conductor according to any preceding claim, the polymeric sleeve material comprising a high-temperature resistant polymer.

10. A composite conductor according to claim 9, the polymeric sleeve material comprising a fluoropolymer or an aromatic polymer.

15

11. A composite conductor according to any preceding claim, the conductive coating material comprising a graphitic or silicon based material.

20 12. A composite conductor according to claim 11, the conductive coating material comprising a high-temperature resistant polymer or paint material which has sufficient of the conductive material incorporated therein to render it conductive.

13. A composite conductor according to claim 11 or claim 12, the conductive coating material being an extruded film.

25

14. A composite conductor according to any preceding claim, the conductor strands being insulated from each other by means of a high-temperature resistant insulating coating applied to each strand during manufacture of the strands before their incorporation into the conductor bundle.

30

15. A composite conductor according to any one of claims 1 to 13, the conductor strands being insulated from each other by means of impregnation of the conductor bundle with a curable high-temperature resistant insulating material during incorporation of the strands into the conductor bundle.

5

16. A process for making a composite conductor, comprising the steps of:
gathering together a plurality of strands of conductor material into a conductor bundle and twisting the bundled strands bodily about a longitudinal centreline of the bundle to form a twisted conductor bundle,

10 impregnating the conductor bundle with a curable high-temperature resistant insulating material, the impregnation occurring one of simultaneously with the gathering and twisting process and subsequent thereto,

 applying a coating of conductive material to the exterior of the twisted conductor bundle to form a first, inner, corona shield,

15 extruding an insulating sleeve of homogeneous polymeric material onto the coating of conductive material on the conductor bundle, the polymeric material having been previously filled with at least one insulating filler material which conducts heat more efficiently than the polymer alone, and

20 applying a coating of conductive material to the outer surface of the insulating sleeve to form a second, outer, corona shield;

 wherein each strand of conductor material is provided with an insulating coating by at least one of coating the strands before the formation of the conductor bundle, and coating the strands during the impregnation step.

25 17. A process according to claim 16, in which after twisting of the bundle, the bundle is formed to a predetermined cross-sectional shape.

18. A process according to claim 17, in which the predetermined cross-sectional shape is rectangular.

19. A process according to any one of claims 16 to 18, in which the impregnated conductor bundle is partially cured before the coating of conductive material is applied to the outside of the conductor bundle.

5 20. A stator for a rotary electrical machine, comprising a laminated steel core provided with a plurality of radially oriented slots extending longitudinally of the stator, each slot housing a winding comprising a plurality of turns of a single length of a composite conductor constituted according to claim 1, successive turns of the composite conductor being in contact and in radial registration with each other.

10

21. A stator for a rotary electrical machine, comprising a laminated steel core provided with a plurality of radially oriented slots extending longitudinally of the stator, each slot housing a winding comprising a plurality of turns comprising a plurality of lengths of a composite conductor constituted according to claim 1,
15 successive turns of the composite conductor being in contact and in radial registration with each other.

22. A stator according to claim 20 or claim 21, the winding being retained in its slot by a high thermal conductivity, electrically insulating retaining means fixed in the
20 radially outer end of the slot.

23. A method of making a stator constituted according to claim 21 or claim 22, in which the conductor bundle has been impregnated with a curable high-temperature insulation material and is wound onto the stator core while the curable high-
25 temperature insulation material is only partly cured, attaching support means to the composite conductor where it is unsupported by the stator slots, and heat treating the completed stator to cure the curable high-temperature insulation material and produce a rigid stator winding.

1/4

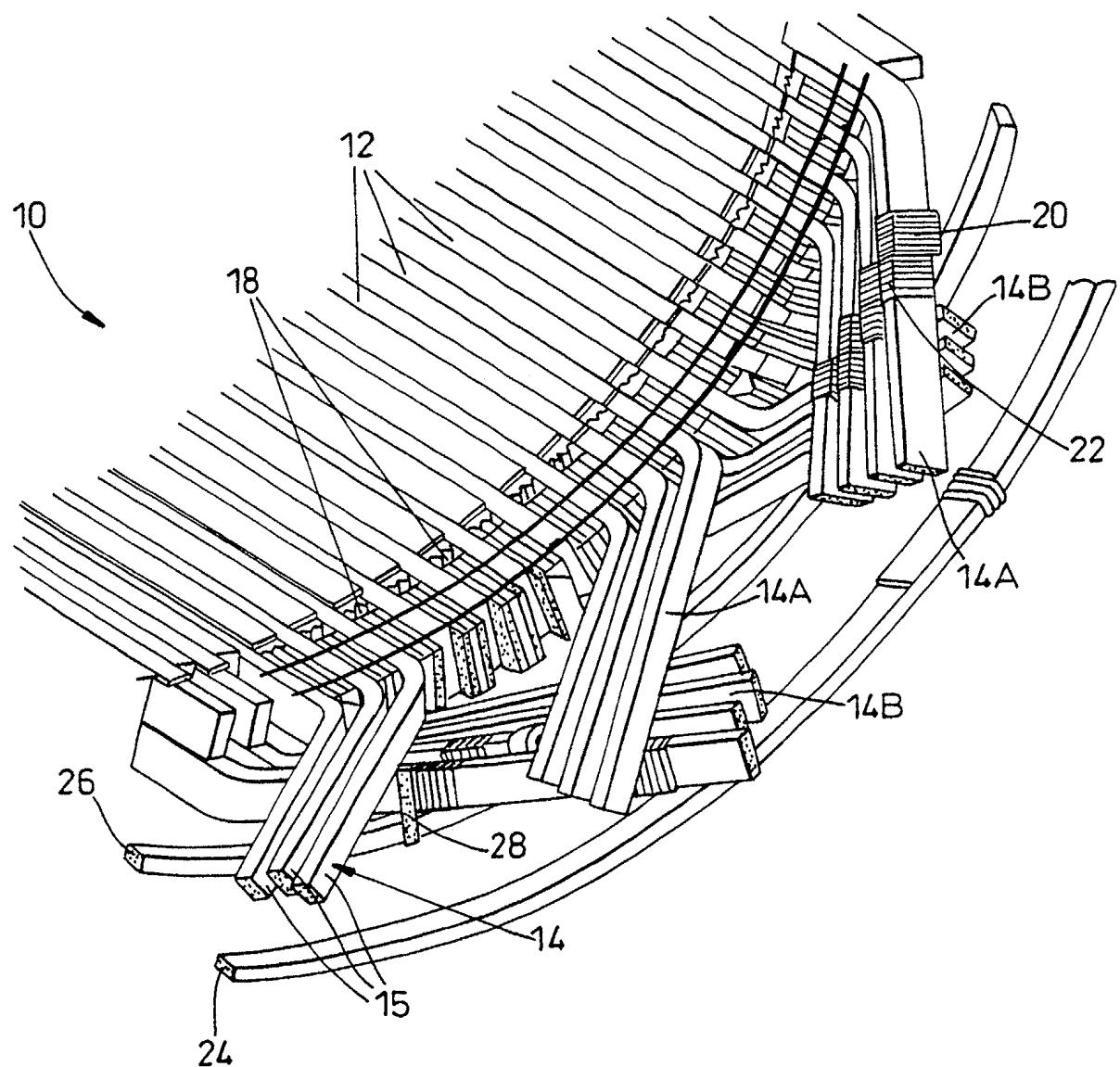


Fig. 1

2/4

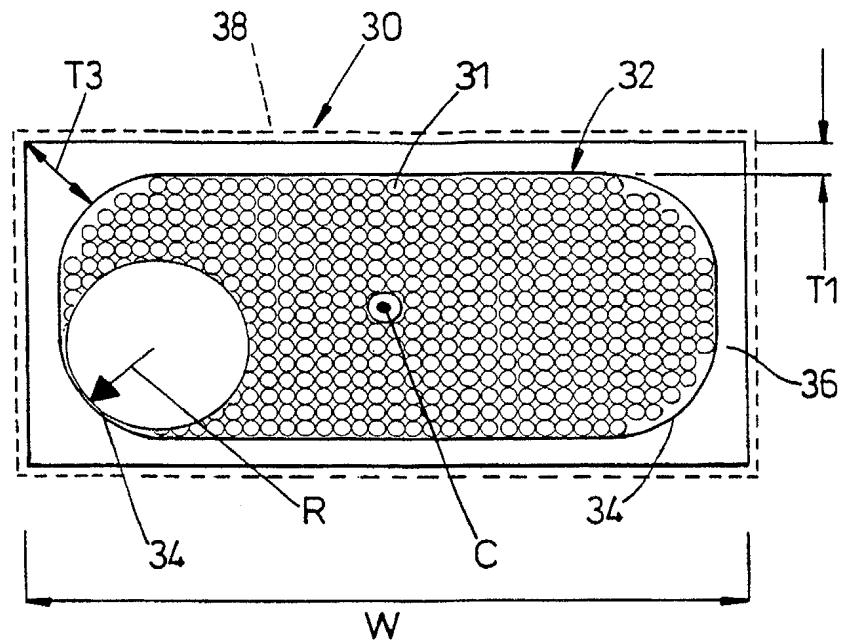


Fig. 2

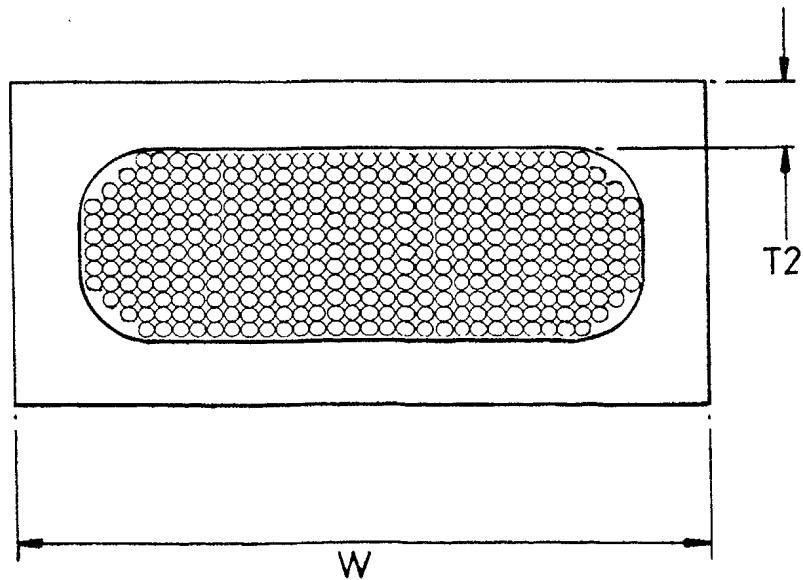


Fig. 3

3/4

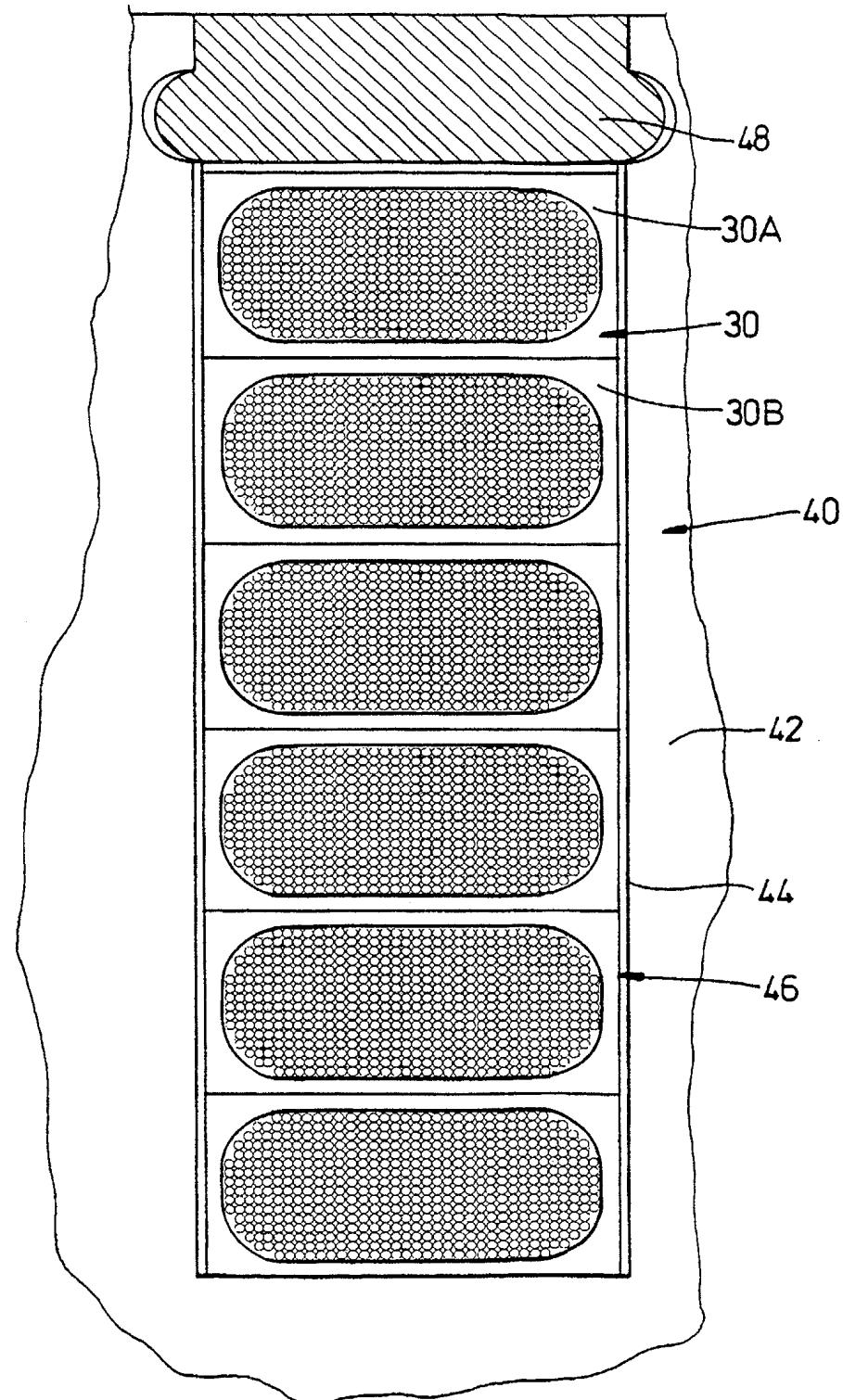


Fig. 4

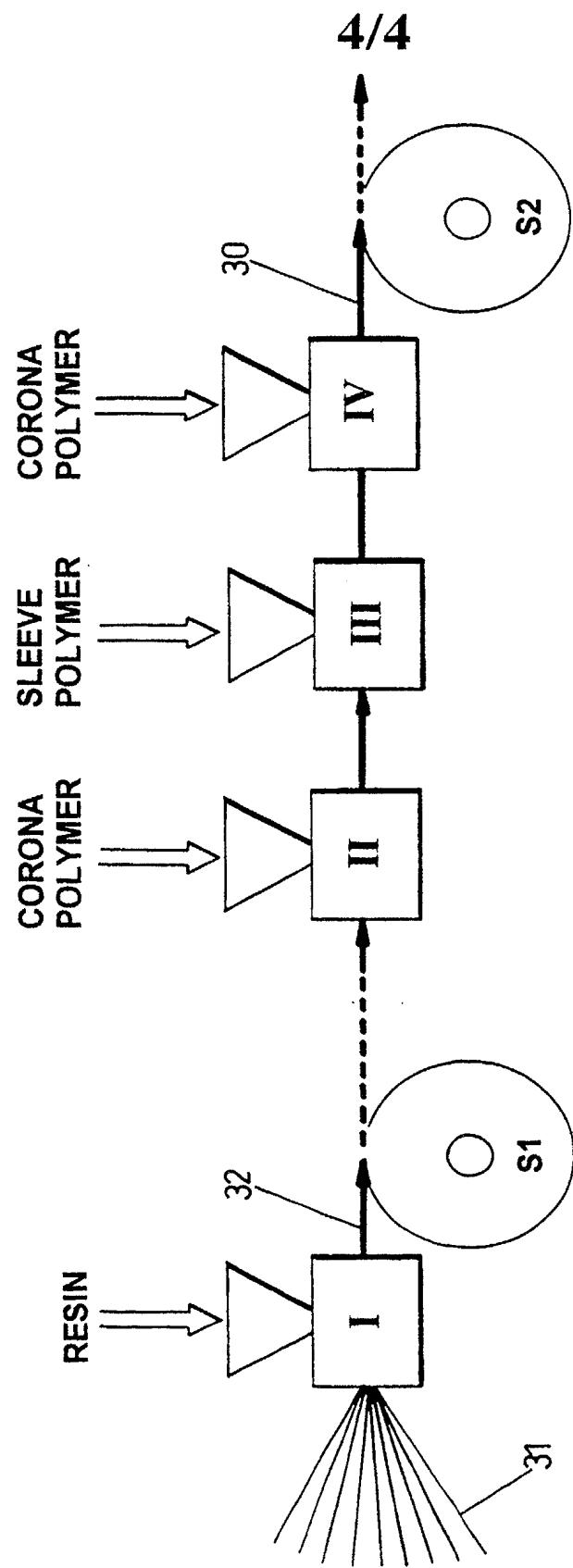


Fig. 5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/01112

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H02K3/40 H02K3/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 266 602 A (ASEA AB) 11 May 1988 (1988-05-11) abstract	1
Y	---	2-6
Y,P	EP 0 951 132 A (ABB RESEARCH LTD) 20 October 1999 (1999-10-20) figures	2-6
X	US 5 710 475 A (BAUMGARTNER CHARLES EDWARD ET AL) 20 January 1998 (1998-01-20) column 2, line 9 -column 3, line 2	1,8-10
X	EP 0 760 282 A (KANEGAFUCHI CHEMICAL IND) 5 March 1997 (1997-03-05) abstract page 3, column 26, line 3 -page 4, column 16	1,8-13
	---	-/-



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

30 June 2000

Date of mailing of the international search report

06/07/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Ramos, H

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/01112

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 195 47 229 A (ASEA BROWN BOVERI) 19 June 1997 (1997-06-19) abstract ---	
A	US 4 008 409 A (RHUDY RALPH G ET AL) 15 February 1977 (1977-02-15) column 6, line 38 -column 6, line 43 -----	

INTERNATIONAL SEARCH REPORT



Information on patent family members

International Application No

PCT/GB 00/01112

Patent document cited in search report	Publication date	Patent family member(s)			Publication date
EP 0266602 A	11-05-1988	SE 455246 B AT 85474 T CA 1289610 A DE 3784008 A DE 3784008 T JP 63110929 A SE 8604509 A US 4806806 A			27-06-1988 15-02-1993 24-09-1991 18-03-1993 24-06-1993 16-05-1988 23-04-1988 21-02-1989
EP 0951132 A	20-10-1999	DE 19817287 A CN 1233101 A JP 11332154 A			21-10-1999 27-10-1999 30-11-1999
US 5710475 A	20-01-1998	NONE			
EP 0760282 A	05-03-1997	WO 9626973 A CA 2185337 A CN 1152275 A WO 9626833 A			06-09-1996 06-09-1996 18-06-1997 06-09-1996
DE 19547229 A	19-06-1997	NONE			
US 4008409 A	15-02-1977	BR 7602220 A ES 446814 A			05-10-1976 01-06-1977

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/01112

Patent document cited in search report	Publication date	Patent family member(s)			Publication date
EP 0266602	A 11-05-1988	SE 455246	B	27-06-1988	
		AT 85474	T	15-02-1993	
		CA 1289610	A	24-09-1991	
		DE 3784008	A	18-03-1993	
		DE 3784008	T	24-06-1993	
		JP 63110929	A	16-05-1988	
		SE 8604509	A	23-04-1988	
		US 4806806	A	21-02-1989	
EP 0951132	A 20-10-1999	DE 19817287	A	21-10-1999	
		CN 1233101	A	27-10-1999	
		JP 11332154	A	30-11-1999	
US 5710475	A 20-01-1998	NONE			
EP 0760282	A 05-03-1997	WO 9626973	A	06-09-1996	
		CA 2185337	A	06-09-1996	
		CN 1152275	A	18-06-1997	
		WO 9626833	A	06-09-1996	
DE 19547229	A 19-06-1997	NONE			
US 4008409	A 15-02-1977	BR 7602220	A	05-10-1976	
		ES 446814	A	01-06-1977	

 PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
 US Department of Commerce
 United States Patent and Trademark
 Office, PCT
 2011 South Clark Place Room
 CP2/5C24
 Arlington, VA 22202
 ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 23 November 2000 (23.11.00)	
International application No. PCT/GB00/01112	Applicant's or agent's file reference 70017.WO/LML
International filing date (day/month/year) 31 March 2000 (31.03.00)	Priority date (day/month/year) 01 April 1999 (01.04.99)
Applicant GLEW, Charles, Neville	

1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:

01 November 2000 (01.11.00)

in a notice effecting later election filed with the International Bureau on:

2. The election was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Juan Cruz Telephone No.: (41-22) 338.83.38
---	---

PATENT COOPERATION TREATY

PCT

REC'D 01 MAY 2001
WIPO
PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

7

Applicant's or agent's file reference P/70017.WOP/LML	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/01112	International filing date (day/month/year) 31/03/2000	Priority date (day/month/year) 01/04/1999	
International Patent Classification (IPC) or national classification and IPC H02K3/40			
Applicant ALSTOM UK LTD.			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 9 sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input checked="" type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input checked="" type="checkbox"/> Certain defects in the international application VIII <input checked="" type="checkbox"/> Certain observations on the international application 			

Date of submission of the demand 01/11/2000	Date of completion of this report 27.04.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer van der Haegen, D Telephone No. +49 89 2399 2683



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/01112

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-16 as originally filed

Claims, No.:

1-26 as originally filed

Drawings, sheets:

1/4-4/4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/01112

the drawings, sheets:

5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):
(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

the entire international application.

claims Nos. 23-26.

because:

the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 23-26 are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet

the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

the written form has not been furnished or does not comply with the standard.

the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N) Yes: Claims 1-7, 9-12, 14-18, 21-22

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/01112

	No:	Claims 8, 13, 19-20
Inventive step (IS)	Yes:	Claims 14-18, 22
	No:	Claims 1-13, 19-21
Industrial applicability (IA)	Yes:	Claims 1-22
	No:	Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01112

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. Claims 23-26 solely rely on references to the drawings (see Section VIII.1 of this report). It is therefore difficult, if not impossible, to determine the matter for which protection is sought by said claims. Hence, no opinion is established for claims 23-26.

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents :

- D1: EP-A-0 266 602 (ASEA AB) 11 May 1988,
- D2: EP-A-0 951 132 (ABB RESEARCH LTD) 20 October 1999,
- D3: US-A-5 710 475 (BAUMGARTNER CHARLES EDWARD ET AL) 20 January 1998,
- D4: EP-A-0 760 282 (KANEKA FUCHI CHEMICAL IND) 5 March 1997,
- D5: DE 195 47 229 A (ASEA BROWN BOVERI) 19 June 1997,
- D6: US-A-4 008 409 (RHUDY RALPH G ET AL) 15 February 1977 and,
- D7: GB-A-1 526 081 (WESTINGHOUSE ELECTRIC CORP.) 27 September 1978.

Document D7 was not cited in the international search report.

- 2.1 The present application does not meet the requirements of Article 33(3) PCT, because the subject-matter of claim 1 does not involve an inventive step, the reason being as follows :
- 2.2 Document D1, which is considered to represent the most relevant state of the art, discloses (cf. Figure 2) :
 - a composite conductor **suitable for** use as a winding of a high voltage

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01112

electrical machine (cf. column 2, lines 52-54),

- a plurality of strands (18) of conductor material forming a conductor bundle (17) which in cross-section is of generally rectangular shape,
- the strands (18) being insulated (19) from each other within the bundle (17),
- an insulation sleeve (14) of substantially homogeneous polymeric material (cf. column 3, lines 30-34),
- the insulation sleeve (14) having a generally rectangular shape in cross-section and,
- the polymeric material being filled with at least one electrically insulating filler material which conducts heat more efficiently than the polymer alone (cf. column 2, lines 1-6).

2.3 The subject-matter of claim 1 differs from this disclosure in that conductive material forming a corona shield coating at the inner and outer surfaces of the insulation sleeve is provided.

The problem to be solved by the present invention may therefore be regarded as to prevent electrical degradation of the insulation sleeve due to corona discharges across voids between the conductor material and the insulation sleeve and across voids between the insulation sleeve and the stator slot walls.

However, a solution to this problem has already been proposed in a similar composite conductor, see document D6, column 4, lines 23-28. It would be obvious to the person skilled in the art, namely when the same result is to be achieved, to apply these features with corresponding effect to a composite conductor according to document D1, thereby arriving at a composite conductor according to claim 1. The subject-matter of claim 1 does therefore not involve an inventive step (Article 33(3) PCT).

3. Rounding the corners of rectangular shaped conductor bundles and insulation sleeves is a measure well-known to those skilled in the art in order to prevent corona discharge at these corners (cf. document D7, page 1, lines 10-22). The solutions provided by subject-matter of claims 2-6 therefore come within the scope of the customary practice followed by persons skilled in the art. Consequently, the subject-matter of claims 2-6 lacks an inventive step.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01112

4. Twisting a conductor bundle around the longitudinal centerline of the bundle in order to reduce losses from eddy currents is a normal design procedure. The subject-matter of claim 7 does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT.
5. The features introduced by the subject-matter of claim 8 are known from document D1 (cf. column 2, lines 1-6).
6. A high-temperature resistant polymeric sleeve material comprising a fluoro polymer or an aromatic polymer is known from document D3 (cf. column 2, lines 30-37). The skilled person would therefore regard it as a normal design option to include this feature in the composite conductor described in document D1 in order to solve the problem underlying claims 9 and 10. The subject-matter of claims 9 and 10 does not therefore involve an inventive step.
7. The subject-matter of claims 11, 11' and 12 is known from document D6 (cf. column 4, line 60 - column 5, line 33). The skilled person would therefore regard it as a normal design option to include these features in the composite conductor described in document D1 in order to solve the problems underlying these claims. The subject-matter of said claims does not therefore involve an inventive step.
8. The features introduced by the subject-matter of claim 13 are known from document D1.
9. Document D1 nor any of the other prior art documents show the additional features introduced by claim 14. The subject-matter of claim 14 is therefore new and involves an inventive step.
- 10.1 Document D1, representing the most relevant state of the art, does not disclose a process for making a composite conductor comprising the steps of :
 - gathering together a plurality of strands of conductor material into a conductor bundle and twisting the bundled strands bodily about a longitudinal centerline of the bundle to form a twisted conductor bundle,
 - applying a coating of conductive material to the exterior of the twisted

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01112

- conductor bundle to form a first, inner, corona shield,
- extruding an insulating sleeve of homogeneous polymeric material onto the coating of conductive material on the conductor bundle, the polymeric material having been previously filled with at least one insulating filler material which conducts heat more efficiently than the polymer alone and,
- applying a coating of conductive material to the outer surface of the insulating sleeve to form a second, outer, corona shield; wherein each strand of conductor material is provided with an insulating coating by at least one of coating the strands before the formation of the conductor bundle, and coating the strands during the impregnation step.

10.2 The problem to be solved may therefore be regarded as to provide a process for making a composite conductor with an insulation sleeve resistant against electrical degradation and with reduced winding losses from eddy currents.

None of the available prior art documents discloses or suggests a process comprising the abovementioned steps. The subject-matter of independent claim 15 is therefore novel (Article 33(2) PCT) and involves an inventive step (Article 33(3) PCT).

11. Claims 16-18 are dependent on claim 15. The subject-matter of said claims is therefore also novel and involves an inventive step.
12. The subject-matter of claims 19-20 is known from document D1 (cf. column 1, lines 5-14).
13. Retaining means for retaining the windings in slots are well-known to those skilled in the art (cf. Document D5, figure 1, reference sign 6). The skilled person would therefore regard it as a normal design option to include this feature in the composite conductor described in document D1 in order to solve the problem underlying claim 21. The subject-matter of claim 21 does not therefore involve an inventive step.
14. Document D1 nor any of the other prior art documents show the method of making a stator according to claim 22. The subject-matter of claim 22 is therefore

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/01112

new and involves an inventive step.

15. The present application is susceptible of industrial application in the sense of Article 33(4) PCT.

Re Item VII

Certain defects in the international application

1. Independent claims 1 and 16 are not in the two-part form in accordance with Rule 6.3(b) PCT, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).
2. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).
3. Claims 11'-26 should be renumbered as claims 12-27.
4. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in documents D1, D3, D6 and D7 is not mentioned in the description, nor are these documents identified therein.
5. According to the requirements of Rule 11.13(I) reference signs not appearing in the description shall not appear in the drawings, and vice versa. This requirement is not met in view of the reference signs **16** (wedge) and **H** (height of insulating sleeve) which appear in the description but not in the figures.

Re Item VIII

Certain observations on the international application

1. According to Rule 6.2(a) PCT, claims should not rely on references to the drawings (see PCT International Preliminary Examination Guidelines, III-4.10). Claims 23-26 solely rely on such references. It is therefore difficult, if not impossible, to determine the matter for which protection is sought by said claims. Claims 23-26 do not meet the requirements of Article 6 PCT.

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 70017.WO/LML	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 00/ 01112	International filing date (day/month/year) 31/03/2000	(Earliest) Priority Date (day/month/year) 01/04/1999
Applicant ALSTOM UK LTD.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :

contained in the international application in written form.

filed together with the international application in computer readable form.

furnished subsequently to this Authority in written form.

furnished subsequently to this Authority in computer readable form.

the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. Certain claims were found unsearchable (See Box I).

3. Unity of Invention is lacking (see Box II).

4. With regard to the title,

the text is approved as submitted by the applicant.

the text has been established by this Authority to read as follows:

5. With regard to the abstract,

the text is approved as submitted by the applicant.

the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

as suggested by the applicant.

because the applicant failed to suggest a figure.

because this figure better characterizes the invention.

2

None of the figures.

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

DARGAVEL, Laurence P.
ALSTOM UK LIMITED
PO BOX 70, Mill Road
Rugby Warwickshire CV21 1TB
GRANDE BRETAGNE

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing (day/month/year)	27.04.2001
-------------------------------------	------------

Applicant's or agent's file reference
P70017.WOP/LML

IMPORTANT NOTIFICATION

International application No. PCT/GB00/01112	International filing date (day/month/year) 31/03/2000	Priority date (day/month/year) 01/04/1999
---	--	--

Applicant
ALSTOM UK LTD.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/ European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Ottaviani, P Tel.+49 89 2399-2225
--	--

